

CLAIMS:

1. A differential read head comprising:
a plurality of tri-layer readers operating in a current perpendicular to plane (CPP) mode, the plurality of tri-layer readers each comprising a first free layer, a second free layer, and a nonmagnetic layer positioned therebetween; and
nonmagnetic spacer means for defining an intrinsic linear resolution of the read head and for electrically connecting the plurality of tri-layer readers in series such that a single CPP sense current representing a differential signal flows serially through the read head.
2. The differential read head of claim 1, wherein a magnetization of the first free layer is antiparallel to a magnetization of the second free layer in a quiescent state.
3. The differential read head of claim 2, wherein quiescent state magnetizations of the first and second free layers are antiparallel due to shape anisotropy.
4. The differential read head of claim 1, further comprising:
biasing means for producing a biasing field perpendicular to an air bearing surface of the differential reader.
5. The differential read head of claim 4, wherein a biasing direction of the biasing means is generally perpendicular to quiescent state magnetizations of the first and second free layers.

6. The differential read head of claim 5, wherein the two free layers have biased magnetizations oriented substantially orthogonal with respect to each other.
7. The differential read head of claim 1, wherein a width of the nonmagnetic spacer at
7. The differential read head of claim 6, wherein magnetizations of the first and second free layers rotate in response to flux emanated from a rotating disc.
8. The differential read head of claim 1, wherein one of the plurality of tri-layer readers is a tunneling tri-layer reader.
9. The differential read head of claim 1, wherein one of the plurality of tri-layer readers is a spin valve tri-layer reader.
10. The differential read head of claim 1, further comprising:
a sense current source for passing a sense current perpendicular to
a plane of the plurality of tri-layer readers and the
nonmagnetic spacer means to detect a change in resistance
across the differential read head.
11. A differential read head having an air bearing surface (ABS) for confronting a surface of a magnetic medium, the differential read head comprising:
first and second tri-layer readers, each tri-layer reader including two
free layers with a nonmagnetic layer positioned between the
two free layers;

a nonmagnetic spacer which defines an intrinsic linear resolution of the read head and which electrically connects the first and second tri-layer readers in series such that a single CPP sense current representing a differential signal flows serially through the read head; and

biasing means for producing biasing fields for the first tri-layer reader and the second tri-layer reader substantially perpendicular with respect to the ABS and substantially antiparallel with respect to each other.

12. The differential read head of claim 11, wherein the two free layers in each tri-layer reader have biased magnetizations oriented substantially orthogonal with respect to each other.

13. The differential read head of claim 11, wherein the biasing means includes a permanent magnet positioned on a side of the first and second tri-layer readers opposite the ABS.

14. The differential read head of claim 11, wherein the biasing means includes antiferromagnetic (AFM) layers exchange coupled to the tri-layer readers on opposite sides of the tri-layer readers along a track width direction.

15. The differential read head of claim 14, wherein a nonmagnetic spacer separates each AFM layer from the tri-layer readers such that a thickness of the nonmagnetic spacer is adjustable to vary an exchange coupling strength between the AFM layers and the tri-layer readers.

16. The differential read head of claim 11, further comprising:
a sense current source for passing a sense current perpendicular to a plane of the two tri-layer readers and the nonmagnetic spacer to detect a change in resistance across the differential read head.
17. A differential read head having an air bearing surface (ABS) for confronting a surface of a magnetic medium, the differential read head comprising:
a tri-layer reader operating in a current perpendicular to plane (CPP) mode, the tri-layer reader comprising two free layers with a nonmagnetic spacer positioned therebetween, the nonmagnetic spacer having a width substantially similar at the ABS to a transition width of the magnetic medium;
biasing means positioned with respect to the tri-layer reader for biasing a magnetization of the free layers substantially parallel to the ABS; and
a sense current source for passing a sense current representing a differential signal perpendicular to a plane of the two free layers and the nonmagnetic spacer to detect a change in resistance across the differential read head.
18. The differential read head of claim 17, wherein the biasing means includes a permanent magnet having a magnetization set parallel to the ABS.
19. The differential read head of claim 17, wherein the biasing means includes an antiferromagnetic layer exchange coupled to each of the free layers.

20. The differential read head of claim 17, wherein the nonmagnetic layer is a tunnel barrier.
21. The differential read head of claim 17, wherein the nonmagnetic layer is a nonmagnetic metal.
22. The differential read head of claim 17, wherein the width of the nonmagnetic spacer is about 20-100 nm.